

## Claims

[c1] A sensor chip for being used in an optical sensor for the characterization or detection or detection and characterization of at least one chemical or bio-chemical or chemical and bio-chemical substance, comprising

a waveguide comprising a substrate and waveguiding material provided thereon, the substrate defining a substrate side of the waveguiding material, a side of the waveguiding material opposed to the substrate side being a cover medium side,

and a waveguide grating structure comprising at least one waveguide grating structure unit, wherein the waveguide and the waveguide grating structure are operable to emit light proportions towards the substrate side or the cover medium side or the substrate side and the cover medium side when light impinges on the waveguide grating structure,

wherein the waveguide grating structure unit comprises at least two sensing pads, each comprising at least one unidiffractive or multidiffractive grating and a bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance,

and wherein at least one of the following two conditions holds:

- (a) the lightwaves guided in the two sensing pads differ in at least one of their polarization, of their mode number and of their wavelength
- (b) the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substances show different specificities or the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of one sensing pad shows no specificity.

- [c2] The sensor chip according to claim 1, wherein light may be radiated from the substrate side into both the first sensing pad and the second sensing pad of a waveguide grating structure unit or light may be radiated from the cover medium side into both, the first sensing pad and the second sensing pad of a waveguide grating structure unit, and wherein the sensor chip is operable to emit light from both sensing pads into the substrate or from both sensing pads into the cover medium side or from both sensing pads into the substrate and into the cover medium side when light impinges on the sensing pads.
- [c3] The sensor chip according to claim 1, wherein one of said sensing pads comprises at least one incoupling grating and at least one outcoupling grating.

- [c4] The sensor chip according to claim 3, wherein the grating periods of the incoupling grating and of the outcoupling grating are different.
- [c5] The sensor chip according to claim 3 wherein the gratings of the two sensing pads are not chirped.
- [c6] The sensor chip according to claim 1, wherein the grating lines of at least one of said gratings define a plane with a first direction (y) parallel to the grating lines and a second direction (x) perpendicular to the first direction and wherein the width of the grating is confined in the first direction (y).
- [c7] The sensor chip according to claim 1, wherein at least one sensing pad of at least one of said waveguide grating structure units comprises at least one incoupling grating and at least one outcoupling grating and wherein the width of the at least one incoupling grating is confined in a first direction (y) parallel to the grating lines and smaller than or equal to or larger than the width of the at least one outcoupling grating in the first direction (y).
- [c8] The sensor chip according to claim 1 wherein the grating lines of at least one of said gratings define a plane with a first direction parallel (y) to the grating lines and a sec-

ond direction (x) perpendicular to the first direction and wherein the gratings of the two sensing pads are adjacent to one another and are spaced with respect to each other in the first direction (y).

- [c9] The sensor chip according to claim 1 wherein the grating lines of at least one of said gratings define a plane with a first direction (y) parallel to the grating lines and a second direction (x) perpendicular to the first direction and that the width of a grating in the second direction (x) is constant as a function of the position along the first direction (y).
- [c10] The sensor chip according to claim 1 wherein the substrate is made of plastics or of glass.
- [c11] The sensor chip according to claim 10, wherein on the plastic substrate an inorganic low refractive index intermediate layer is arranged.
- [c12] The sensor chip according to claim 1, wherein the waveguiding material comprises a waveguiding film made of a high refractive index material.
- [c13] The sensor chip according to claim 12, wherein the waveguiding material forms a waveguiding film of a high refractive index material and a polymer layer.

- [c14] The sensor chip according to claim 1, wherein the waveguiding material forms a waveguiding film that is not coplanar to a side of the substrate opposed to the waveguiding material.
- [c15] The sensor chip according to claim 14, wherein said side of the substrate opposed to the waveguiding material comprises at least one of wedges, prisms, cylindrical prisms, spherical lenses and of cylindrical lenses.
- [c16] The sensor chip according to claim 1, wherein the waveguiding material comprises at least one sol-gel-layer or a high refractive index lead-silicate glass layer or a photopolymerizeable high refractive index layer or a polymer layer or a PVD layer or a CVD layer or a combination thereof.
- [c17] The sensor chip according to claim 1, wherein the grating structures consist of UV curable organic or inorganic materials or organic/inorganic composites.
- [c18] The sensor chip according claim 1, wherein the grating structures have been manufactured by an embossing technique, a photolithographic technique or a casting technique or an injection molding technique or by laser ablation combined with at least one of an interferometric technique, a holographic technique and of a phase mask

technique.

- [c19] The sensor chip according claim 1, wherein the chemosensitive or bio-chemosensitive or chemosensitive and bio-chemosensitive substances are arranged in chemosensitive or bio-chemosensitive or chemosensitive and bio-chemosensitive layers.
- [c20] The sensor chip according claim 1, wherein the waveguide contains the chemosensitive or bio-chemosensitive or chemosensitive and bio-chemosensitive substances.
- [c21] The sensor chip according to claim 1, wherein the chemosensitive or bio-chemosensitive or chemosensitive and bio-chemosensitive substance of the first sensing pad shows specificity for one ligand with or without non-specific binding, whereas the chemosensitive or bio-chemosensitive or chemosensitive and bio-chemosensitive substance of the second sensing pad shows no specificity with or without non-specific binding.
- [c22] The sensor chip according to claim 1, wherein the chemosensitive or bio-chemosensitive or chemosensitive and bio-chemosensitive substance of the first sensing pad shows specificity for one ligand with or without non-specific binding, whereas the chemosensitive or bio-

chemosensitive or chemosensitive and bio-chemosensitive substance of the second sensing pad shows a different specificity for a second ligand with or without non-specific binding.

- [c23] The sensor chip according claim 1, wherein disturbances of the measuring signal which are caused by non-specific bindings in one sensing pad may be eliminated, by referencing, by means of a measurement at the other sensing pad.
- [c24] The sensor chip according to claim 1, wherein the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substances are such that a first ligand binds to the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of the first sensing pad at the surface and a second ligand binds to the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of the second sensing pad at the surface, or that a first ligand binds to the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of the first sensing pad in the interior and a second ligand binds to the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of the second sensing pad in the interior, or that a first ligand binds to the bio-chemosensitive or

chemosensitive or bio-chemosensitive and chemosensitive substance of the first sensing pad in the interior and a second ligand binds to the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of the second sensing pad at the surface, or that a first ligand binds to the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of the first sensing pad at the surface and in the interior and a second ligand binds to the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of the second sensing pad in the interior,

or that a first ligand binds to the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of the first sensing pad at the surface and in the interior and a second ligand binds to the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of the second sensing pad at the surface,

or that a first ligand binds to the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of the first sensing pad at the surface and in the interior and a second ligand binds to the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of the second sensing pad at the surface and in the interior.

- [c25] The sensor chip according to claim 1, wherein the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of the first sensing pad and the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of the second sensing pad are both dextran but with differing identification molecules.
- [c26] The sensor chip according to claim 1, wherein the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of at least one sensing pad is dextran without an identification molecule.
- [c27] The sensor chip according to claim 1, wherein the bio-chemosensitive or chemosensitive or bio-chemosensitive and chemosensitive substance of at least one sensing pad comprises at least one of antibodies, of receptors and of DNA sections.
- [c28] The sensor chip according to claim 1, wherein a well or a matrix of wells is arranged on the waveguide grating structure or in the waveguide grating structure.
- [c29] The sensor chip according to claim 1, wherein a flow-through cell or a matrix of flow-through cells is arranged on the waveguide grating structure or in the waveguide grating structure.

- [c30] The sensor chip according to claim 1, wherein a capillary vessel or a matrix of capillary vessels is arranged on the waveguide grating structure or in the waveguide grating structure.
- [c31] The sensor chip according to claim 1, wherein the waveguiding material on the substrate comprises a plurality of layers.
- [c32] The sensor chip according to claim 1, wherein the waveguide is a monomode waveguide.
- [c33] The sensor chip according to claim 1, wherein in the waveguide grating structure unit or in at least one of said waveguide grating structure units one sensing pad is formed to be a signal sensing pad and one sensing pad is formed to be a reference sensing pad.
- [c34] The sensor chip according to claim 1, wherein the two sensing pads are illuminated simultaneously.
- [c35] The sensor chip according to claim 1, wherein as a light source a LED or a laser diode is provided.
- [c36] The sensor chip according to claim 1, wherein at least one of said gratings comprises at least the diffraction order zero.

[c37] The sensor chip according to claim 36, wherein at least one of said gratings comprises next to diffraction order zero also higher diffraction orders.